

Key Result Area 2: Waterway Corridor Management

"It is impossible to step into the same river twice."

—Heraclitus (from Plutarch), 535-475 BC

Desired Result

Waterway corridors that function to minimize flood-induced loss of life, protect property and floodplain ecology; preserve natural stream channel stability; provide recreational access; and support healthy aquatic and riparian ecosystems.



What Does Waterway Corridor Management Mean?

We recognize that our waterway corridors—streams, rivers, lakes, and their adjacent, interdependent landscapes serve multiple functions. We must integrate our efforts to manage these corridors as:

- Natural resources for conveying flood waters
- High quality waters for safe recreational enjoyment and as cultural and historical amenities for our communities
- Habitat for diverse and productive biological communities

What is the Importance of Waterway Corridor Management?

Traditionally, our approach to managing waterway corridors has tended towards single-issue programs: wetland protection, stream encroachment limits, structural flood reduction projects, regulation of floodplain development, and site-specific recreation and access projects. More recently, our knowledge of the multiple functioning of stream corridors has improved. As we come to better understand the multiple functions waterway corridors serve, we need to incorporate this understanding into our decision-making.

Integrated management seeks to accommodate the multiple functions and needs of waterway corridor systems and incorporates them in decision-making. For example, when we design a transportation project to span a waterway, care must be taken so that the structure does not negatively impact or impede the natural ability of the corridor to convey floodwaters, transport sediment, and minimize erosion. Innovations in bridge design and structural flood control, floodplain property acquisition, accurate floodplain mapping, stormwater management, streambank restoration, and floodplain regulations aimed at not adversely impacting the corridor can all contribute to protecting or restoring stream corridors.

Waterway corridors are necessary for flood management.

Flooding occurs in all watersheds and along coastal areas. Flooding in undeveloped watersheds is part of natural hydrologic variability, and while it may be temporarily damaging, it provides benefits to the ecosystem. Floodwaters carry mineral-rich sediment, which improves soil productivity when deposited upon the floodplain. Where watersheds and floodplains are developed, flood damage is primarily due to the placement of structures and human activities within an area that is susceptible to flooding. Changes in land cover within a watershed frequently increase the area susceptible to flooding. Building occupied structures within a floodplain ensures vulnerability to flood hazard, property damage, and potential loss of life. Existing floodplain development has made adequate flood warning a priority in order to provide lead-time for emergency actions to prevent loss of life and property.

WHAT IS A WATERWAY CORRIDOR?

A waterway corridor is a stream, river, or lake, and the portion of its adjacent landscape that directly affects and is affected by its hydrology and ecology. The Basin's waterway corridors connect to create networks, enabling a variety of species to migrate between aquatic and terrestrial environments, and from one region of the Basin to another.

In Figure 7 the topographic floodplain represents the uppermost limits of flood water levels associated with storm events. This level is much higher than the flood levels that maintain and shape natural stream channels, including: 1) the hydrologic or riparian flood level that maintains riparian wetland communities (a return period of 2-20 years); 2) bankfull flood levels that transport the majority of a stream's natural sediment load and shape the dimensions and patterns of natural streams (return period of 1-1.5 years); 3) stream base flows, which are entirely supported by ground water supply, maintain habitat of aquatic organisms during low flow periods.

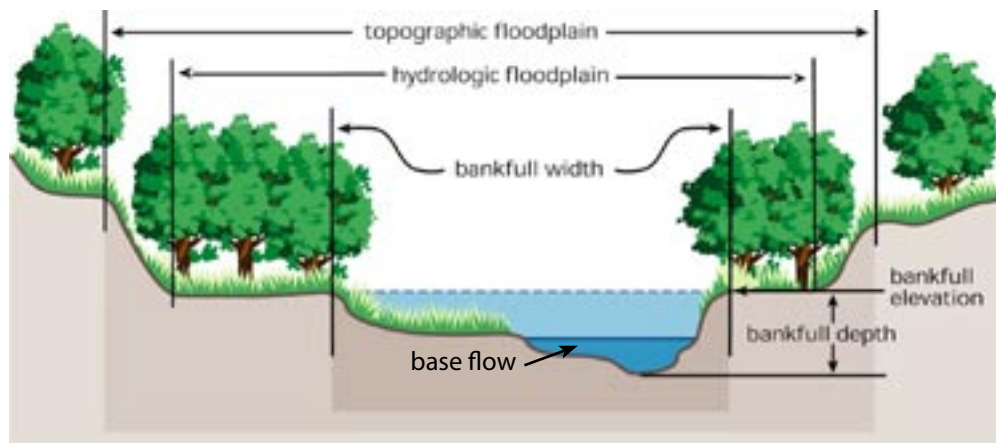


Figure 7: Cross-sectional illustration of a waterway corridor (from Stream Corridor Restoration: Principles, Processes, and Practices. Federal Interagency Stream Restoration Working Group (FISRWG) 1998)

We must manage not only for extreme floods which threaten lives and infrastructure, but also for the riparian flood, the bankfull flood, and baseflow conditions. Impacts of development, such as stormwater runoff and stream encroachment, can alter the frequency and energy of these more frequent floods, which are necessary to support wetlands, natural channel stability, and fisheries.

The Basin's waterways are important recreation venues and community amenities.

Rivers and lakes of the Delaware River Basin are located within a day's drive of about 20 percent of the US population. The Basin includes National Wild and Scenic Rivers, the Appalachian Trail, and numerous game lands, parks, and forests.

Recreational activities range from passive (such as wildlife or landscape photography) to active (hiking, fishing, trapping, hunting, canoeing, boating, white-water rafting). They include activities along the waterways as well as on or in the waters themselves. Waterway use is dependent on adequate public access along the streams, rivers and the Bay. Insensitive use of the waterways, streambanks and trails can impair both the visual and functional value of the resource. Physical and visual access to water, whether for recreation or inspiration, adds dimension to our quality of life and enhances the attractiveness of our communities.

Waterway corridors provide essential aquatic and riparian habitat.

Waterway corridors function as transportation networks and food sources for wildlife, and provide habitat for shelter and propagation for aquatic and terrestrial species of plants and animals. Forested buffers provide temperature control, keeping

the water cool and shaded from sunlight. This helps maintain a more constant environment for temperature-sensitive species, and stabilizes dissolved oxygen levels. Vegetation also helps to stabilize stream banks, reducing erosion and minimizing disruption to aquatic habitats. Fallen trees provide woody debris that serves as a refuge for aquatic species.

Excessive high flows and inconsiderate recreational use can physically impair waterway corridors, threatening the health of natural ecosystems. Making our waters “fishable” means creating an aquatic environment supportive of healthy fish and wildlife, as well as having finfish and shellfish safe for human consumption.

THE BENEFITS OF BUFFERS

Leaf Food	<i>Leaves and woody debris provide food and habitat for insects, crustaceans, amphibians and small fish</i>
Filtering Runoff	<i>Buffers slow runoff and settle out sediment, nutrients and pesticides before they reach streams and lakes</i>
Infiltration	<i>Rates in vegetated buffers can be 10-15 times higher than grassed turf and 40 times higher than plowed fields</i>
Canopy and Shade	<i>Leafy canopies provide shade, keeping water cool, retaining dissolved oxygen, and encouraging the growth of beneficial algae and aquatic insects</i>
Habitat	<i>Wooded corridors provide the most diverse habitats for fish and other wildlife, especially valuable for birds</i>
Nutrient Uptake	<i>Fertilizers and other pollutants are stored in limbs and roots • Bacteria in the forest floor convert harmful nitrate to nitrogen gas which is released into the air</i>

Source: Alliance for the Chesapeake Bay, 1996

Goals for Waterway Corridor Management

- 2.1 Prevent or minimize flood-induced loss of life and property, and protect floodplain ecology.
- 2.2 Enhance water-based recreation in the River and its tributaries.
- 2.3 Protect, conserve and restore healthy and biologically diverse riparian and aquatic ecosystems.

GOAL 2.1: Prevent or minimize flood-induced loss of life and property, and protect floodplain ecology.

Identifying areas and structures within a community that are at risk from flooding is the single most important step in mitigating future flood damage and loss. Community planning to reduce flood damage is also important, and guidance is available from federal and state agencies that can help communities in this effort. In addition, flood forecasting and warning, maintenance of flood control structures, and stormwater management are all essential elements of controlling future flood damage.

Assessing flood hazards. Flood hazard information must be made available to communities so that they can identify structures at risk and develop mitigation plans. This should include generalized methods that can help communities plan to prevent structural loss.

Developing pre- and post-development mitigation strategies. The Disaster Mitigation Act of 2000 requires that all municipalities and states develop hazard mitigation plans in order to remain eligible for post-disaster mitigation grants. Pre-development strategies might include floodplain management, stormwater management, and property acquisition along stream corridors. Post-development strategies might range from maintenance of existing flood control structures to



Bayside residents get flood fighting help from the US Army Corps of Engineers.

elevation or removal of buildings from the flood hazard area by property relocation or buy-out and demolition. In addition, streambank restoration could follow building relocation or demolition.

The practice of removing stormwater from a site as quickly as possible, or controlling only its peak flow rate but not its volume, combined with the extensive clearing of forested land that historically precedes human settlement, has altered the hydrology of many watersheds in the Basin, severely in some instances. The importance of stormwater management to reduce both ecosystem and property damage, along with steps to improve our current system of management, is explained in greater detail in Key Result Area 3: Land and Water Resource Management.

Linking flood control and stormwater management. Coordinating flood mitigation and stormwater management involves a vast array of agencies, departments, offices and programs at all levels of government. A more detailed assessment of this challenge can be found in Key Result Area 4: Institutional Coordination and Cooperation.

Taking steps to minimize the ecological impacts of floods. Landscape alterations that occur with human settlement include intrusions into the floodplain— structures, roads, bulk heading, and the filling of wetlands— intrusions that can interfere with both watershed hydrology and the floodplain's ability to convey water. This rapid and damaging erosion and deterioration of stream channels, and the associated ecological consequences, can be minimized through a combination of regulations and responsible development decisions for stormwater and floodplain management and wetlands preservation.

STORMWATER CONTROL AND FLOODING

Human activities, such as the extensive clearing of previously forested land and poor stormwater management practices subsequent to development, have significantly altered the hydrology of many watersheds in the Basin. Poor stormwater practices include conveyance of water from a site as quickly as possible, thereby overburdening downstream areas, or controlling only the peak rate of discharge, but not its total volume. The importance of proper stormwater management in reducing damage to the ecosystem and to human property, as well as steps to improve our current system of management, are discussed in greater detail in Key Result Area 3: Land and Water Resource Management.

Enhancing flood forecasting. No matter what assessments and mitigation strategies are implemented, adequate warning with regard to impending or potential flood events remains key to minimizing loss of life in flood events. The accuracy and reliability of hydrologic forecasting depend on adequate monitoring of precipitation and stream flow. In support of this task, funding should be secured for the implementation of "Recommendations to Address Flood Warning Deficiencies in the Delaware River Basin," prepared in May 2002 by the Delaware River Basin Commission, with technical guidance from the DRBC Flood Advisory Committee.

HOW DEVELOPMENT EXACERBATES FLOOD IMPACTS

Flood waters that would be retained in the headwaters or allowed to spread into the floodplains are quickly transported by the conduits of paved roadways or storm sewer pipes directly into the waterway. Overburdened with flood water, the water gains speed and power, picks up sediment and debris, and rushes down waterways too constricted by development to function properly. This increases scour on the sides and bottom of waterways, uprooting plants and eliminating substrate for bottom-dwelling species.

Increasing awareness. Community leaders, residents and developers need to be informed about the natural functions of waterway corridors in flood mitigation, the risks that accompany inappropriate development in the floodplain, and the need for hazard mitigation and stormwater management plans to mitigate hazardous conditions or prevent them from occurring. (See also Key Result Area 3, Goals for stormwater management; and Key Result Area 5, Goals for increasing awareness and stewardship.)

GOAL 2.2: Enhance water-based recreation in the River and its tributaries.

The Basin's National Wild and Scenic Rivers, the Appalachian Trail, numerous game lands, parks and forests can be linked to optimize recreational experiences.

Creating a Delaware Basin recreation use and access plan. The need exists for regional recreational use and access planning that provides for overall integrated management of recreation and tourism, protects water resources from recreation impacts, provides enjoyment and convenient access, and protects the health and safety of recreational users. A Basin-wide recreation and tourism plan should include strategies to: 1) Promote the Basin as a tourist destination; 2) Provide additional public access to waterways; 3) Create a linked water trail system; 4) Increase the scope and frequency of stream and river trash collection; 5) Maintain or improve recreational water quality; 6) Avoid impacts from recreational use; and 7) Improve the connections of communities to their waterways.

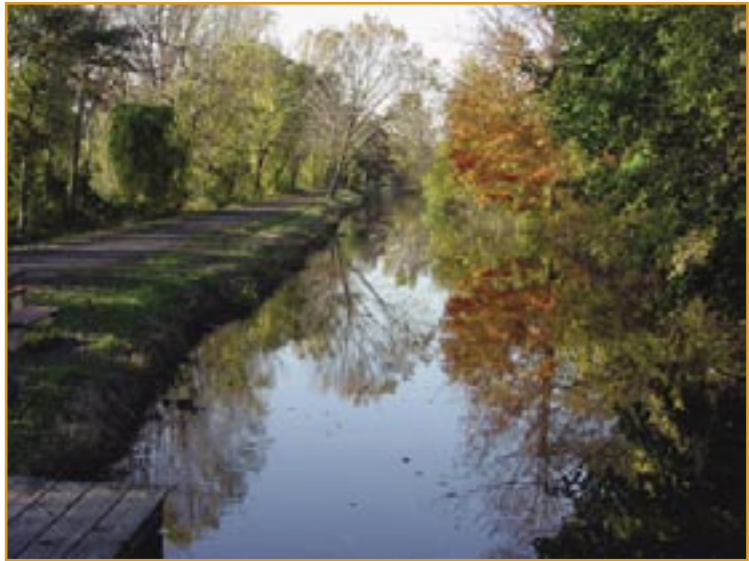
The streams and rivers of the Basin are attractive and natural transportation routes, yet are often isolated from one another, and are located on or very near private property, or lack access sites or safety features. Hazards abound near urban areas, in the vicinity of dams, and where high-speed roads and railroads share space with recreational users and few amenities are available to travelers along water corridors.

Inconsiderate recreational use can degrade environmental quality, especially through physical impacts to sensitive riparian ecologies. Challenges lie in understanding thresholds and, where necessary, setting limits to human use.

Coordinated efforts will be needed to expand access and enhance the recreation experience of the river-using public. Numerous entities in the Basin are involved in providing recreation and tourism services, yet regional connections are lacking: between towns along waterways; between user and provider communities; and between states. Implementation of recreation and tourism objectives will require a serious coordination effort of public and private entities.

Promoting visual and physical access to waterways in community development plans. This will require concerted efforts to educate developers, officials, and the public about the opportunities waterway corridors can offer for recreation, and the need to promote access through local planning. Legal barriers to increasing public access need to be investigated.

Developing operating plans for reservoirs. Public and private reservoirs serve a variety of important purposes, including public water supply, power generation, flow augmentation and flood control. They also provide recreational opportunities (both at the facilities and downstream). Facility functions may be prescribed by statute and/or subject to regulatory approvals of the Delaware River Basin Commission, the Federal Energy Regulatory Commission or other agencies, and their operating plans must reflect their prescribed functions.



An autumn view of the Delaware and Raritan Canal in Mercer County, New Jersey.

GOAL 2.3: Protect, conserve and restore healthy and biologically diverse riparian and aquatic ecosystems.

The health of natural plant and animal communities requires that flows in fresh water rivers and streams exhibit the natural range of variation in the flow regime, especially seasonally. Other physical and chemical parameters are also critical to the health of ecosystems. Understanding the range of needs for the diverse native aquatic and riparian populations within the Basin is a challenge in itself.

Defining flow regime and water quality criteria to support diverse and abundant aquatic and riparian communities. Ecosystem needs for flow and for water quality vary seasonally with the life cycles of aquatic and riparian species. Criteria are dependent on topography, elevation and geology and are specific to the assemblages of populations in a region, a watershed, or a stream's reach.

Investigating fresh water inflow requirements for estuarine ecosystems in the tidal portion of the Basin. Present policy consists of meeting a flow target for the Delaware River at Trenton, NJ. The target is designed to maintain the 30-day average chloride concentration at or below 180 ppm at river mile 98 during repetition of drought-of-record conditions to be protective of industrial and potable supply needs. Currently a model is employed to forecast salinity changes based on projected changes to the flow regime. Up-to-date information on climate change and sea level rise should be used when evaluating projected estuary conditions and freshwater inflow needs of estuarine systems should be established and incorporated into flow scenario evaluation.

Incorporating ecosystem requirements in water quality criteria and flow targets. The Basin states are using biological and physical criteria in addition to traditional chemical criteria for assessment and protection of aquatic life and there has been increased monitoring of biological assemblages, habitat conditions, stream morphology, and riparian conditions to determine overall ecological integrity of the Basin's waters.

Coordination and cooperation among agencies and non-governmental organizations is necessary to effectively assess and manage the Delaware River and its tributary watersheds, including the setting of water quality criteria to support consistent designated uses throughout the Basin. These criteria will not just be the minimum acceptable for the survival of adults, but support and protect all life stages and the reproduction of aquatic and riparian communities.

Employing restoration techniques to improve impaired waters or maintain the ecological functions of waterways and riparian lands. Some forms of restoration are simple, such as removal of dams to improve water quality and fish passage in streams, and to prevent disruption of floodplains and riparian zones. Other restoration and protection measures are very complex, such as protection, replacement or restoration of wetlands, riparian forests, modified stream channels, and flow regimes. These will require large investments in research and agency support, but they can be successfully accomplished in the near future with major benefit to water resources.

Environmental restoration is a fairly new field, and information needed to determine objectives and predict ecological response to restoration measures is sparse. After millions of years of modification, restoration of landscapes and waterways is presently as much an art as a science, and will remain so without coordinated and sustained regional cooperation.

Protecting riparian and aquatic ecosystems. Commercially significant species thrive on a food base of non-game mammals, birds, fish, reptiles, amphibians, mussels, and invertebrates supported by the Delaware River and Bay. It is important to identify and protect the habitat and life stage requirements of key commercial, recreational, game, non-game, threatened, and endangered species so that they survive and successfully reproduce throughout their natural ranges.

- Implement invasive species management. Competition from invasive species is second only to habitat loss in its impact on ecosystem integrity. Identifying invaders, their means of distribution, and means of controlling those offers a tremendous ecological and economic challenge.